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# **Applying change management to general aviation: Pilot self-briefings for weather**

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## **ABSTRACT**

General aviation (GA) pilots are increasingly relying on available weather technology to conduct preflight weather self-briefings, rather than call-in briefings to Flight Services. However, research has shown that GA pilots' have difficulty in interpreting weather products, such as radar, and that this problem persists even after additional training. The domain of change management examines how to properly plan and implement transitions in technology. The current paper examines this transition from call-in to self-briefing using principles of change management, specifically from the Unified Theory of Acceptance and Use of Technology.

## **BACKGROUND**

In the U.S., 88% of all weather-related accidents occur in General Aviation (GA) (Federal Aviation Administration, 2010). Among these, 61.9% are fatal. In fact, from 1982 to 2013 25% of 58,687 GA accidents cited weather as the primary contributing factor (Fultz & Ashley, 2016). The National Transportation Safety Board (NTSB) goes on to specify that it is "improper understanding and misutilization" of weather information that can be dangerous- possibly more so, than not having the information at all (NTSB, 2014). During preflight planning, GA pilots obtain weather information related to their flight route. Historically, GA pilots have accomplished this with telephone calls to Flight Services. Today, GA pilots can access all necessary weather information using the internet and perform a weather "self-briefing." In fact, the FAA encourages GA pilots to adopt the self-briefing approach, which for many pilots is a major change in their flight planning processes.

A body of research literature exists regarding change management in organizations (Maes & Geert, 2019; Arazmjoo & Rahmanseresht, 2019; Bullock & Batten, 1985; Burke & Litwin, 1992), but there is limited (if any) research of change management principles within the context of aviation preflight weather planning. Applying this perspective to the on-going technology transition regarding weather information for GA pilots may generate insights on system design and

pilot training. Thus, the purpose of the current paper is to describe the ongoing transition in GA from telephone call-in weather briefings to self-briefings from the perspective of change management theory, and to provide theory driven implications for the weather technology transition.

## **GENERAL AVIATION AND WEATHER PREFLIGHT BRIEFINGS**

Prior to flight, GA pilots are required to obtain a weather pre-flight briefing to learn the current and forecasted weather conditions along their flight path. Specifically, the Federal Aviation Administration (FAA) (2019) states, "*prior to every flight, pilots should gather all information vital to the nature of the flight. This includes a weather briefing obtained by the pilot from an approved weather source via the Internet, and/or from a Flight Service Station (FSS) specialist.*"

Until about 15 years ago, pilots obtained their weather pre-flight briefing through a telephone call to a live Flight Service Specialist. Using phone-in briefings, the pilots had access to experts who reviewed, interpreted, and described the weather conditions relating to the pilots' proposed flights. Today, using internet technology, the task of obtaining weather information has changed.

Now, pilots can access relevant weather information using an aviation app (e.g., Foreflight) or

websites such as the Aviation Weather Center. Pilots can view relevant weather conditions such as cloud cover, precipitation, wind direction and speed, as well as read pilot reports (PIREPs), view up-to-date radar information, forecasts, and other meteorological information. With the accessibility of the weather information, pilots no longer depend on call-in briefings. In fact, the FAA is transitioning away from call-in preflight briefings to GA pilots conducting their own self-briefing.

It is imperative to ensure that safety is maintained throughout the transition to weather self-briefings and that new processes adopted by pilots do not threaten any established safety (Guerra, Carmichael & Nielson, 2016). Thus, it is important that this transition be monitored and measured for effectiveness and safety. Fortunately, a body of research exists on the topic of change management, which will be discussed next.

## CHANGE MANAGEMENT AND TECHNOLOGY

The domain of change management is about creating a controlled and planned transition from one state to another, in this case, from call-in to self-briefing for preflight planning. The Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003) will be used as a change management framework to analyze this adoption of pilot self-briefing for weather.

The literature on change management addresses many aspects involved with initiating or facilitating change, most often at an organizational level. Some areas of research include organizational culture (Lofquist, 2011; Schimmel, & Muntslag, 2009; Burnes, & Jackson, 2011; Kunda, 1992), organizational discourse (Barrett, Thomas, & Hocevar, 1995), shared mental models (Aguste, 2013; Hicks et al., 2004; Sulistiyani, Ali & Astuti, 2020; Corrigan et al., 2015), and performance metrics (Kattner, Wang, & Lindemann, 2016; Leva, Del Sordo & Mattei, 2015). The definition of change management can be as varied as its research areas thus, for the purposes of this paper, change management is defined as a controlled and planned implementation of a new technology.

Venkatesh et al., (2003) developed a meta-model to explain user intentions to use a new technology and the subsequent usage behavior. The model consolidates the constructs from eight models in the literature (i.e., Theory of Reasoned Action, Technology Acceptance Model, Motivational Model, Theory of Planned Behavior, a combined Theory of Planned Behavior/Technology Acceptance Model, Model of Personal Computer Utilization, Innovation Diffusion Theory, and Social Cognitive Theory).

These eight models were tested within four different organizations over six months, and the results explained between 17-53% of user intention. In contrast, the combined UTAUT model was tested within those same organizations and outperformed the 8 models with an adjusted  $R^2$  of 69%. The model was then tested within two new organizations which resulted in an adjusted  $R^2$  of 70%. The domains in which this model was tested were business account management, accounting, sales, product development, customer service, and research on financial investment opportunities and IPOs (Venkatesh et al., 2003).

As shown in Figure 1, the Venkatesh model consists of four core determinants of usage whose impact are then moderated by four constructs, as

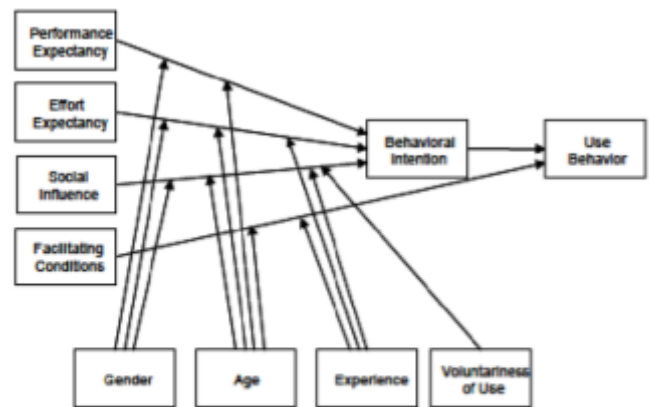


Figure SEQ Figure \` ARABIC 1: Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh, Morris, Davis & Davis, 2003)

illustrated in their model below. The constructs are measured using surveys and will be described next.

### Performance Expectancy

Performance expectancy is the degree to which an individual believes that using the system will help them attain gains in job performance (Venkatesh et al.,

2003). The performance expectancy construct is the strongest predictor of intention within each individual model and remains so in both voluntary and mandatory settings.

*Implication for GA weather self-briefing.*

Relating to GA pilots, the expectancy would be the degree to which the pilots viewed the new technology as helpful for them to understand the weather and plan for the flight. The more that pilots believe the technology will help them prepare for flight, the more likely the pilots will be to use the technology.

Performance expectancy is moderated by both *age* and *gender*. A recent meta-analysis found that age was overall negatively correlated to perceived ease of use, perceived usefulness, and intention to use a technology (Hauk, Huffmeier & Krumm, 2017). However, this research also revealed that the negative correlation of age and perceived usefulness only existed for certain technologies and likely relates to the nature of aging – as people age, their needs shift from knowledge accumulation/growth towards meaning/social needs (Hauk et al., 2017). With regard to technologies addressing knowledge acquisition, the results indicated that, again, age was negatively correlated with perceived usefulness (i.e., younger people tended to perceive higher utility of technology). The age-perceived usefulness relationship is mediated by perceived ease of use, however. This means that if younger users do not perceive the system to be easy to use, then their view of the usefulness no longer correlates. Furthermore, if users do not perceive that a system is easy to use, they also report an overall lowered intention to use.

*Implication for GA weather self-briefing.* Many GA pilots are middle-aged or older. It may be that these pilots are less accepting of the new technology.

*Implication for GA weather self-briefing.* If the users do not perceive the new weather technology as easy to use, they may be more reluctant to self-brief and may desire to call-in.

Gender differences (most with roots in societal gender roles) within technology adoption are lessening over time as computers and computer applications become essential for work and in peoples' personal lives (Li, Glass, & Records, 2008). Performance expectancy is

therefore moderated by gender and age resulting in the highest impact being on younger adults, possibly young men.

*Implication for GA weather self-briefing.* To become a GA pilot both genders become acquainted with advanced technology thus it may be even less likely to see traditional gender differences impacting the adoption of weather self-briefing.

## **Effort Expectancy**

Effort expectancy is the degree of ease the individual associates with using the system. For GA pilots this would be the degree of ease associated with accessing and interpreting the online weather information during the self-briefing.

This construct is significant in both voluntary and mandatory settings but can become insignificant in both after the first training with the new technology. This is thought to occur because issues are initially seen as “hurdles to overcome” but are later overshadowed by “instrumentality concerns” (Venkatesh et al., 2003). This means that the issues are no longer part of a learning-curve, but are genuine problems with the technology itself. Effort expectancy is predicted to be more salient for women than men due to gender differences with roots in societal gender roles, as previously mentioned with performance expectancy. However, this proposition may not apply to aviation, where female pilots are well accustomed to interactions with technology.

In terms of age, Plude and Hoyer (1985) found that processing complex stimuli and allocating attention becomes more difficult as individuals age, which may lead to increased difficulty in using software systems. Research is needed to determine if this finding exists in the GA domain.

*Implications for GA weather self-briefing.* Research indicates weather information interpretation errors occur in pilots of all levels of flight certificate and ratings (Blickensderfer et al., 2018). If the pilots are aware of these difficulties they may have a low effort expectancy rating for the weather displays.

*Implication for GA weather self-briefing.* In some domains, effort expectancy is most salient for older women with relatively little experience with technology, as it is moderated by gender, age, and experience. This finding may not apply to GA, however. Research is needed to examine the effort expectancy construct relating to GA pilots use of online weather information.

## **Social Influence**

Social influence is the degree to which an individual perceives that “important others” believe they should use the new system. Within aviation “important others” would likely be more experienced pilots or flight instructors. This construct is not significant in voluntary settings, but is significant when use is mandated. However, social influence in mandatory settings is only significant when the individual is just *beginning* to use the technology. Thus, as an operator’s experience with the system increases the effect of social influence decreases. Social influence is a direct determinant of behavioral intention as an individual’s behavior can be changed by how they perceive important others view them as a result of whether or not they use the new technology.

Previous research conducted by French and Raven (1959) and Warshaw (1980) has shown that individuals will be more likely to modify their behavior in compliance when their referent others can reward or punish them if they are not using the new technology. This is consistent with social influence being significant in only mandatory settings.

*Implications for GA weather self-briefing.* Pilots-in-training are likely to be highly influenced by the opinions of their flight instructors. This could be an opportunity for flight instructors to advocate for effective use of the self-briefing technology.

Gender also moderates social influence as others’ opinions are more highly valued by women when forming their intention to use the system. This effect declines with experience as an individual’s intention to use the system shifts from being socially driven to more instrumentally based. Rhodes (1983)

found that as people age their affiliation needs increase. This suggests that social influence will be more salient to older workers, yet the effect still declines with experience. Thus, social influence will be moderated by gender, age, voluntariness of use, and experience meaning the effect will be strongest for older women when use is mandated.

*Implication for GA weather self-briefing.* Research is needed to assess the degree these relationships exist in GA.

## **Facilitating Conditions**

Facilitating conditions is the degree to which an individual believes an organizational and technical infrastructure exists to support use of the new technology. For pilots this would be the degree to which the pilots believe the FAA and other organizations have created supports surrounding self-briefing adoption. If effort expectancy was not accounted for, facilitating conditions would become a direct predictor of intention to use. Facilitating conditions directly influence use behavior and also develop post-use (Venkatesh et al., 2003). That is, as experience with a new system increases, the users learn avenues for help and support within the organization. Having multiple sources for assistance removes impediments for sustained use. Hall and Mansfield (1975) found that older employees assign more value to receiving help and assistance at work. Venkatesh and their team (2003) believe this would be particularly salient when using new software systems as increased age is associated with increased cognitive and physical limitations. Facilitating conditions are therefore moderated by age and experience and expected to be especially salient for older users with increased experience.

*Implication for GA weather self-briefing.* For GA pilots, one example of facilitating conditions is the degree to which the FAA has supports to guide the adoption of self-briefing as well as the supports found within the actual tools for weather self-briefing (e.g., within Foreflight, within the AWC websites, etc.)

*Implication for GA weather self-briefing.* GA pilots have a relatively high median age. Thus, ensuring a variety of facilitating conditions (i.e., opportunities for support) could encourage those pilots who do not want to self-brief to learn to use the technology.

## SUMMARY AND CONCLUSION

Widespread accessibility to preflight weather briefing tools has made self-briefing, as opposed to call-in briefing, more accessible than ever. However, some populations may be hesitant to adopt this technology. Further understanding of the transition is needed to facilitate its adoption and ensure pilots are able to safely conduct their preflight weather briefings. Principles of change management, specifically from the Unified Theory of Acceptance and Use of Technology, can be used to monitor this transition and pinpoint impediments to the adoption of this technology so that educational and safety interventions can be designed as necessary.

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